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GEOPHYSICAL VARIABLES AND BEHAVIOR: LXXXIV. QUANTITATIVE INCREASES IN GROUP AGGRESSION IN MALE EPILEPTIC RATS DURING INCREASES IN GEOMAGNETIC ACTIVITY[1]

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Summary.—Over a 24-day period the magnitude of the average, 24 hr., global geomagnetic activity was significantly correlated (*r* and *rho* about .40) with the average numbers of agonistic (biting) responses between midnight and 0100 hr. in a group of four male epileptic rats. Geomagnetic activity was not significantly correlated with quantitative measures of boxing, mounting, eating, grooming, or drinking. Partial correlations, which also controlled for a weak serial correlation, indicated that the index of geomagnetic activity was only associated with the biting (partial $r = .54$) behaviors. The results replicated previous studies and suggest that the relationship between group aggression and geomagnetic activity is specific and not an artifact of a generalized increase in multiple domains of behavior.

Rats in which limbic epilepsy has been induced by a single systemic injection of lithium and pilocarpine exhibit more frequent overt seizures during 24-hr. periods of increased geomagnetic activity or when exposed to experimental fields that simulate the natural conditions (Michon & Persinger, 1997). Groups of these rats have displayed moderate correlations between inferred measures (numbers of recorded squeaks) of internal aggression and average daily geomagnetic activity (Persinger, 1997). The present study was designed to discern (1) which of two agonistic behaviors, boxing or biting, was most correlated with geomagnetic activity and (2) whether this association was specific to aggressive behaviors or associated with generalized increases in other activities.

Four male rats, approximately 80 days old, were injected subcutaneously with 3 mEq/kg of lithium followed 4-hr. later by 30 mg/kg of pilocarpine; forelimb clonus (overt seizures) were verified and then attenuated with 30 mg/kg of acepromazine (Persinger, Makarec, & Bradley, 1988). Seven days later they were housed in a single, custom-constructed, plastic cage (Persinger, 1997) for the remainder of the study. After seven days, the experiment began; however unlike previous studies, the rats were separated by plastic doors except during the 1-hr. observation. Food and water were available *ad libitum*. The night phase of the 12:12 hr. light:dark cycle began at 19:30 hr.

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For 24 successive nights during November and December 1997, between midnight and 0100-hr. the plastic doors were lifted and the rats were allowed to interact. The numbers of bites (defined as dental contact with another rat) and the numbers of episodes of boxing, mounting, grooming, eating, and drinking were recorded for each rat. The rats were then returned to their individual compartments during the subsequent 23 hr. After the study was completed the daily aa (average antipodal index) of geomagnetic activity for the northern hemisphere was obtained from the Geomagnetic Indices Bulletin (National Geophysical Data Center, 325 Broadway, Boulder, Colorado 80303).

Zero-order correlational (parametric and nonparametric) analyses were completed by SPSS software among the six behavioral measures for each of the four rats and for the average of the four rats as a function of the daily geomagnetic activity. The mean and standard deviation for the daily aa values for this period were $M=9.4$, $SD=7.1$ (range=3 through 32). The means and standard deviations for the averaged numbers (per hour) for the behavioral measures were for boxing $M=42$, $SD=18$, bites $M=1.8$, $SD=1.6$, grooming $M=10.6$, $SD=2.5$, drinking $M=6.1$, $SD=2.5$, eating $M=1.4$, $SD=1.2$, and mounting $M=2.3$, $SD=3.7$.

Although the numbers of biting and boxing responses were significantly correlated .55, only the association between daily geomagnetic activity and biting ($rho=.38$; $r=.42$) was statistically significant. The correlations for biting with the index of geomagnetic activity during each of the previous two days were not significant ($rho=.30$; $r=-.01$). Individually, three of the four rats' biting responses were significantly correlated with the daily geomagnetic activity ($rho=.41$, .51, and .42). Partial correlations of boxing and biting with aa values, to indicate recondite associations, confirmed the association of increased geomagnetic activity and numbers of biting responses.

To control for possible serial effects, time (days) was partialled out before the correlation was completed between geomagnetic activity and biting; the partial r_{21} value was .54 ($p<.01$). There were, however, no statistically significant correlations between any of the other behavioral measures with time. These results confirm previous observations that periods of increased geomagnetic activity, above 20 nT and during the local scotophase, can encourage aggressive behavior between male rats with labile limbic systems. The possibility of simulating by experimental design the critical components of geomagnetic activity that precipitate such group aggression must now be pursued.

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